ARIZ 730
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(6 Pages)

# GEOTEXTILE FABRIC PERMITTIVITY MEASUREMENT BY THE FALLING HEAD METHOD

(An Arizona Method)

## SCOPE

1. This procedure provides for the determination of the permittivity for a geotextile fabric sample as determined by a falling head permeameter test.

## APPARATUS

2. The apparatus shall consist of the following:

(a) Falling head fabric permeameter consisting of a 2 inch (5.08 cm) inside diameter Plexiglas standpipe with a cross-sectional area of 20.27 $cm^2$ above a fabric sample placed over a 1 inch (2.54 cm) diameter orifice, to provide a cross-sectional area of flow through the test fabric of 5.07 $cm^2$. The water entry port shall be below the orifice for the sample. (See Figure 1).

(b) Water supply with tubing and shutoff valve to provide water into the standpipe.

(c) Fabric thickness gauge that meets the requirements outlined in ASTM D1777.

(d) Celsius thermometer for water temperature measurement.

(e) Stopwatch with measurement to the nearest tenth of a second.

(f) Rubber gasket of approximately, but not less than, the thickness of the fabric to be tested. The gasket shall have an opening in the center with a diameter of 10 cm, and an outside diameter of approximately 15 cm.

(g) Large plastic ball water release valve with lever at the base of the standpipe, just below the water entry port.

## SAMPLE PREPARATION

3. (a) Cut a circular fabric sample to fit the opening of the rubber gasket (10 cm diameter).

(b) Measure and record the thickness of the fabric sample according to the procedure outlined in ASTM D1777

(c) Place the fabric sample on the bottom flange of the permeameter, and place a rubber gasket of appropriate thickness around the fabric.

(d) Position the bottom portion of the permeameter, with fabric and gasket in place, at the base of the standpipe and secure the bottom flange against the top flange with clamps. Place a container, of adequate size to catch released water, below the permeameter outlet.

## TEST PROCEDURE

4. (a) The object of this procedure is to determine the time required for water to travel through the fabric as the height of the water column is reduced from $h_0$ to $h_1$.

(b) The values for $h_0$ and $h_1$ in this test procedure are 20 cm and 10 cm respectively above the fabric sample. These low head levels are specified to provide water flow characteristics within or close to the laminar range.

(c) The elapsed time (t) for the ($h_0$ - $h_1$) condition is determined as follows.

(d) With the sample in place and the water release valve in the closed position, fill the standpipe with water through the water entry port below the flange, until a water level of 10 to 15 cm above the desired starting height of $h_0$ (20 cm) is achieved, then shut off the water supply valve.

(e) Tap the assembly gently a few times to release any trapped air bubbles from the system.

(f) Open the water release valve and watch the water level fall toward the starting height of 20 cm.

(g) When the water level reaches the starting height of 20 cm, immediately start the timer and continue to watch the water level fall toward the ending height of 10 cm.

(h) When the water level reaches the ending height of 10 cm, immediately stop the timer.

(i) If further tests are desired, close the water release valve, otherwise allow the water to flow completely out of the standpipe.

(j) Record the time (t) from the stopwatch.

(k) Repeat the procedure given in paragraphs (c) through (j) above an additional three times, and calculate an average time ($t_a$) for the geotextile fabric sample.

(l) Measure and record the temperature of the water which flowed out of the standpipe.

## CALCULATIONS

5. Calculate the permittivity of the geotextile fabric sample according to the following equation:

$$\text{Permittivity} = \left\{\left[\frac{a}{A \cdot t_a}\right] ln\,(h_0 / h_1)\right\} R_t$$

Where: $a$ = cross-sectional area of standpipe ($cm^2$)

$A$ = cross-sectional area of orifice ($cm^2$)

$t_a$ = time in seconds for flow from $h_0$ to $h_1$

$h_0$ = starting water level

$h_1$ = ending water level

$R_t$ = water temperature correction factor

The water temperature correction factor $R_t$ is determined from the graph shown in Figure 2 based on the water temperature measured previously. When the temperature of the water is 20 degrees C, the correction factor is 1. A higher temperature results in a correction factor below 1 since the viscosity of water decreases with temperature. This lower viscosity would result in higher water flow through the fabric.

For the apparatus described in this test procedure, the equation becomes:

$$\text{Permittivity} = \left[\frac{2.7712}{t_a}\right] R_t$$

## REPORT

6. The permittivity shall be reported to at least the nearest three decimal places.

# FALLING HEAD FABRIC PERMEAMETER

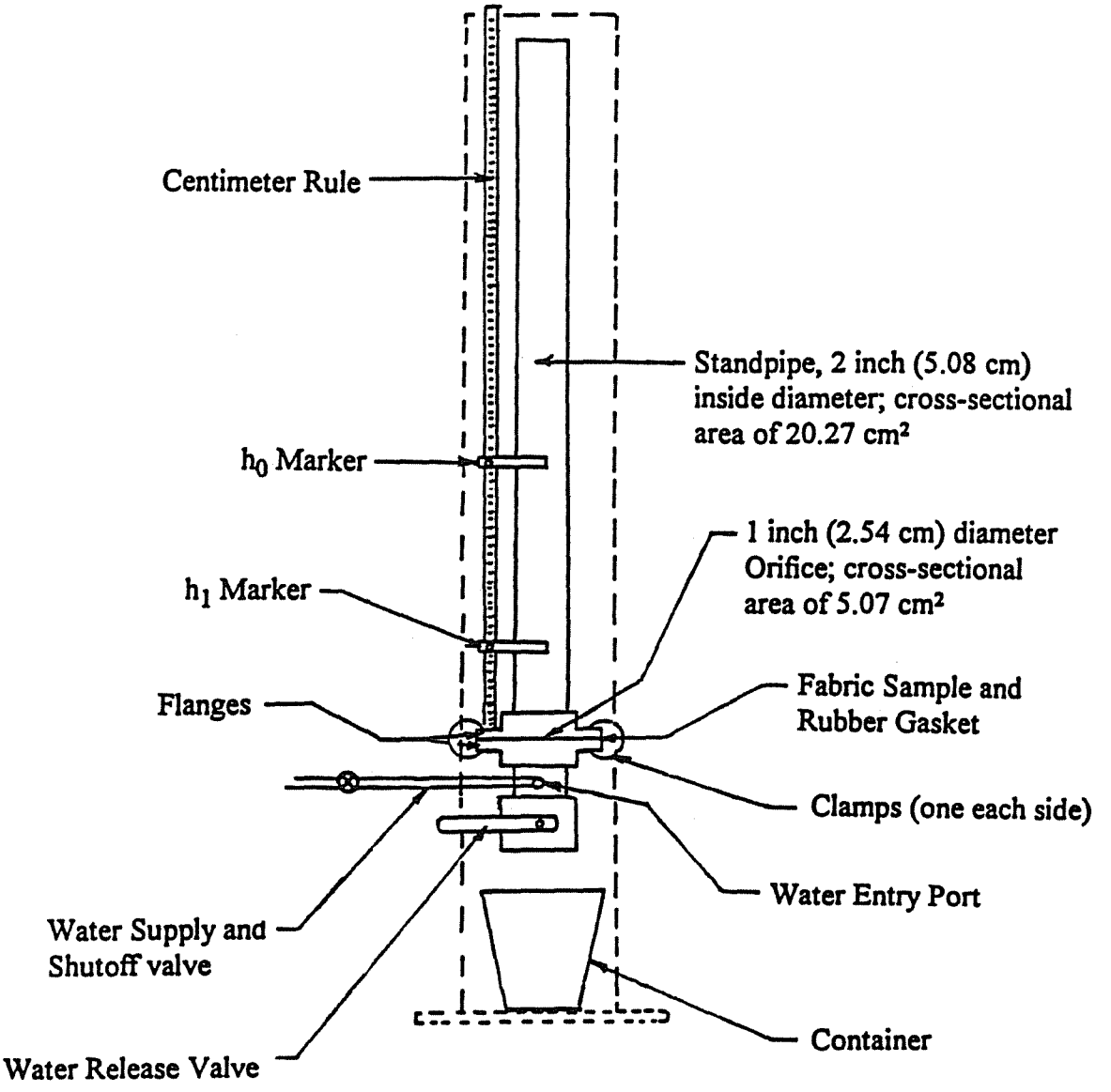


**FIGURE 1**

## $R_t$ VERSUS TEMPERATURE

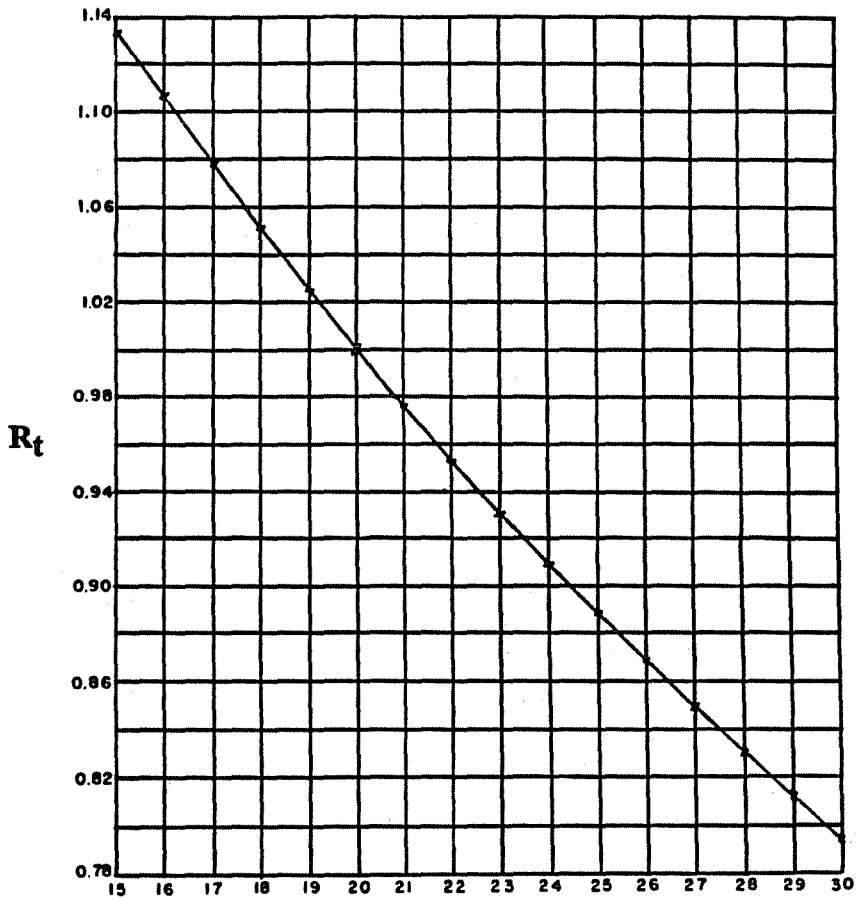


FIGURE 2